TRIGONIOIDIDAE (MOLLUSCA: BIVALVIA) FROM THE CRETACEOUS OF LAKE EYRE NORTH, SOUTH AUSTRALIA

by N. H. LUDBROOK*

Summary

LUDBROOK, N. H. (1985) Trigonioididae (Mollusca: Bivalvia) from the Cretaceous of Lake Eyre North, South Australia. *Trans. R. Soc. S. Aust.* **109**(3), 77-82, 29 November, 1985.

Pledgia eyrensis gen. et sp. nov., a species of bivalve mulluse apparently belonging to the Trigonioididae, an important family of non-marine Mollusca in the Cretaceous of Eastern, Central and South-East Asia, is described. The bivalves weather out from unconsolidated fine sand and silt mapped as Winton Formation on the western side of Babbage Peninsula, Lake Eyre North, in the southern part of the Great Artesian Basin. No likely non-marine ancestral forms have been found among the Unionidae and it is possible that ancestors of *Pledgia eyrensis* may be found in the Trigoniidae.

KEY WORDS: Mollusca, Bivalvia, Trigonioididae, Cretaceous, Winton Formation, Lake Eyre North, Great Artesian Basin.

Introduction

In 1982 a number of grey-coloured, thick-shelled bivalves collected in July from an outcrop on the western side of Babbage Peninsula, Lake Eyre North, were shown to me by Mr Neville Pledge of the South Australian Museum. Similar material had been collected in 1967 by Dr B. Daily of the University of Adelaide. Thought to be of possible Miocene age, those collected earlier were taken to the National Museum of Victoria for identification. As their preservation and colour were similar to Cretaceous marine fossils from the Lake Eyre region and not to Tertiary molluscs of the area, I considered those shown to me to be non-marine Cretaceous bivalves which I had not previously seen in the Cretaceous of the Great Artesian Basin. The material taken to Victoria was then returned to augment that in the South Australian Museum.

Since the original material was collected, the LAKE EYRE 1:250 000 map sheet has been published (Williams 1975). Outcrops of Winton Formation (Cenomanian) are shown west of the fault on the western side of Babbage Peninsula (Fig. 1).

The molluscs were found weathering out from sandy silt to unconsolidated fine sand mapped as Winton Formation, towards the base of a low bluff 4 m high. There is a possibility, not yet substantiated, that the sandy silt has been reworked from the Winton Formation. The locality was revisited in May 1983 by G. W. Krieg and P. A. Rogers of the Geological Survey of South Australia who made further collections from the site and provided the composite section shown in Fig. 2. The Winton sediments are overlain by a layer of massive crystalline gypsum up to 1.5 m thick in which occasional bivalves were found reworked. This is followed by pale olive-grey gypsiferous sand and a compact gypsum crust.

In all, 19 more-or-less complete valves and 274 fragments were collected. Some of the specimens were sent to the Geological Survey of Queensland and the Queensland Museum to see whether similar molluscs had ever been found in the Winton Formation in Queensland, but none were known to have been collected there.

They seem to belong to the family Trigonioididae, an important family of non-marine molluscs in the Cretaceous fauna of Eastern, Central and South-East Asia (Yang 1974), previously not known to occur in the Southern Hemisphere.

The family Trigonioididae and its distribution

The family name Trigonioididae was introduced by Cox (1952) to accommodate the genera *Trigonioides* Kobayashi & Suzuki, 1936 and *Hoffetrigonia* Suzuki, 1940 in the Unionacea rather than in the Trigoniacea; Cox excluded from consideration or did not accept those genera as belonging to the Trigoniidae where they had originally been placed. Later (1955) Cox withdrew the family Trigonioididae, considering *Trigonioides* to be a normal representative of the Unionidae. Kobayashi (1956) restored the Trigonioididae as a valid family which has been generally accepted since then and classified within the Unionacea. Eighty-four species have been described, distributed among ten genera and seven subgenera. A second family Peregrinoconchiidae with seven species was described by Gu, Chen & Lan (*in* Lan 1976), while Martinson (1984) erected the superfamily Trigonioidea to include three families:

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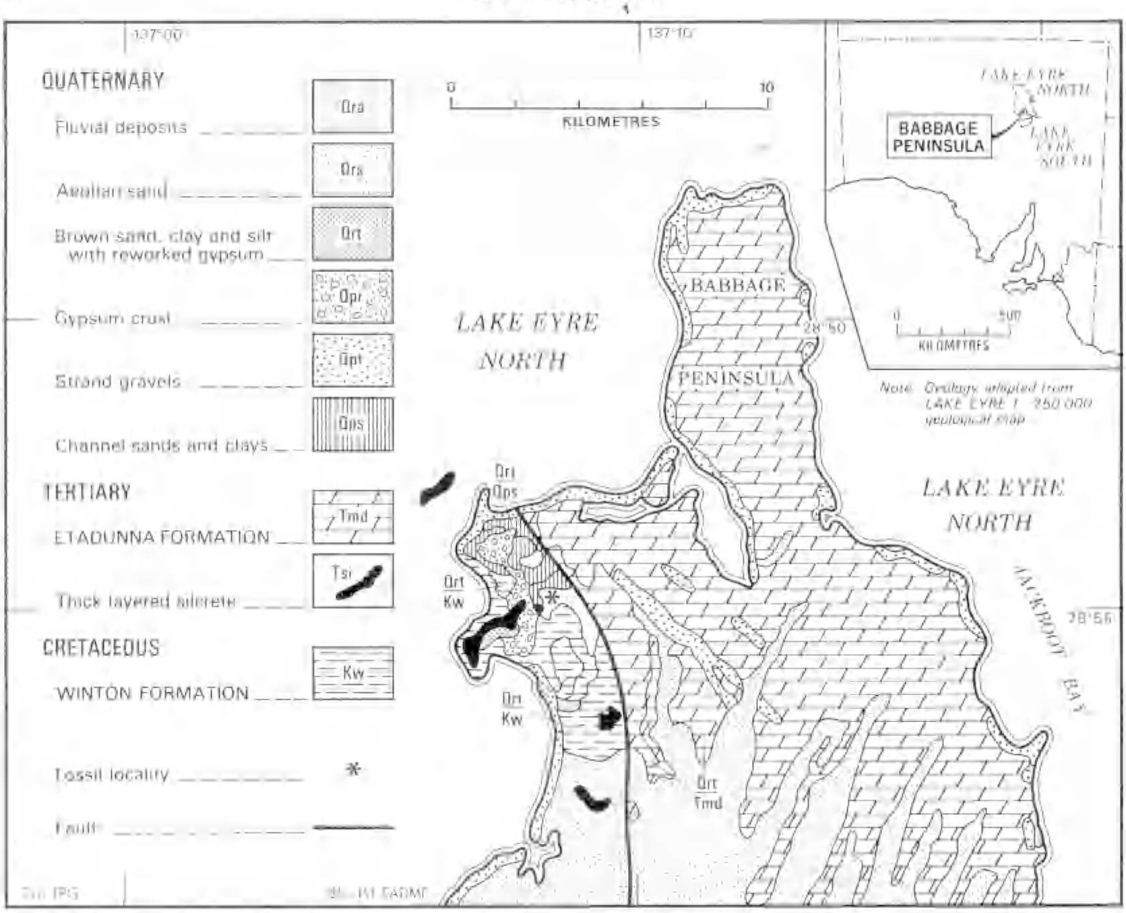

Fig. 1. Locality plan with geology of Babbage Peninsula (lake sediments blank).

Trigonioididae, Pseudohyriidae and Sainshandiidae (= Sainschandiidae). Martinson's classification is at present available in abstract only.

The present known distribution of the Trigonioididae in Asian non-marine basins is (Kobayashi 1958): Northern Asia—Lena Basin and eastern Siberia
Eastern Asia—Amur River—Manchuria
Japan and Korea
Mongolia—northwest China.

One species has been described from Colorado USA (MacNeil *in* Morris 1936).

The Lake Eyre bivalves

The bivalves from Lake Eyre resemble Trigonioididae from eastern Asia chiefly in the structure of the hinge; the sculpture differs in that the radial or chevron patters of the costae are at best vestigial and the dominant sculpture is finely concentric. The interior of the ventral margin is not crenulated.

According to Kobayashi (1958), the Trigonioididae appeared 'sporadically and explosively in the maritime basins of eastern Asia at the beginning of the Cretaceous.' The family was considerably augmented in the Lower and Middle Cretaceous by the recognition of important genera such as *Plicatounio* and *Nipponaia* (Ota 1959a, 1959b, 1963). Kobayashi attributes this sudden appearance to some geological event which caused a change in environment, marine bivalves being locked in inland basins during the Sakawa cycle of orogeny. Nevesskaya & Soloviev (1981) show the maximum development of the Trigonioididae to be from the Cenomanian to the Santonian, with minor occurrence in the Campanian and Maastrichtian. Martinson (1984) considers the Trigonioididae to be characteristic of the Early Cretaceous and the Pseudohyriidae and Sainschandiidae of the Late Cretaceous. Reconciliation of these apparent discrepancies will presumably be found in the full text of Martinson's paper when it becomes available.

The age of the Winton Formation at Lake Eyre is considered to be Cenomanian (Ludbrook 1978, Moore 1982, Forbes 1982) or latest Albian to Cenomanian (Moore & Pitt 1982, Krieg 1982).

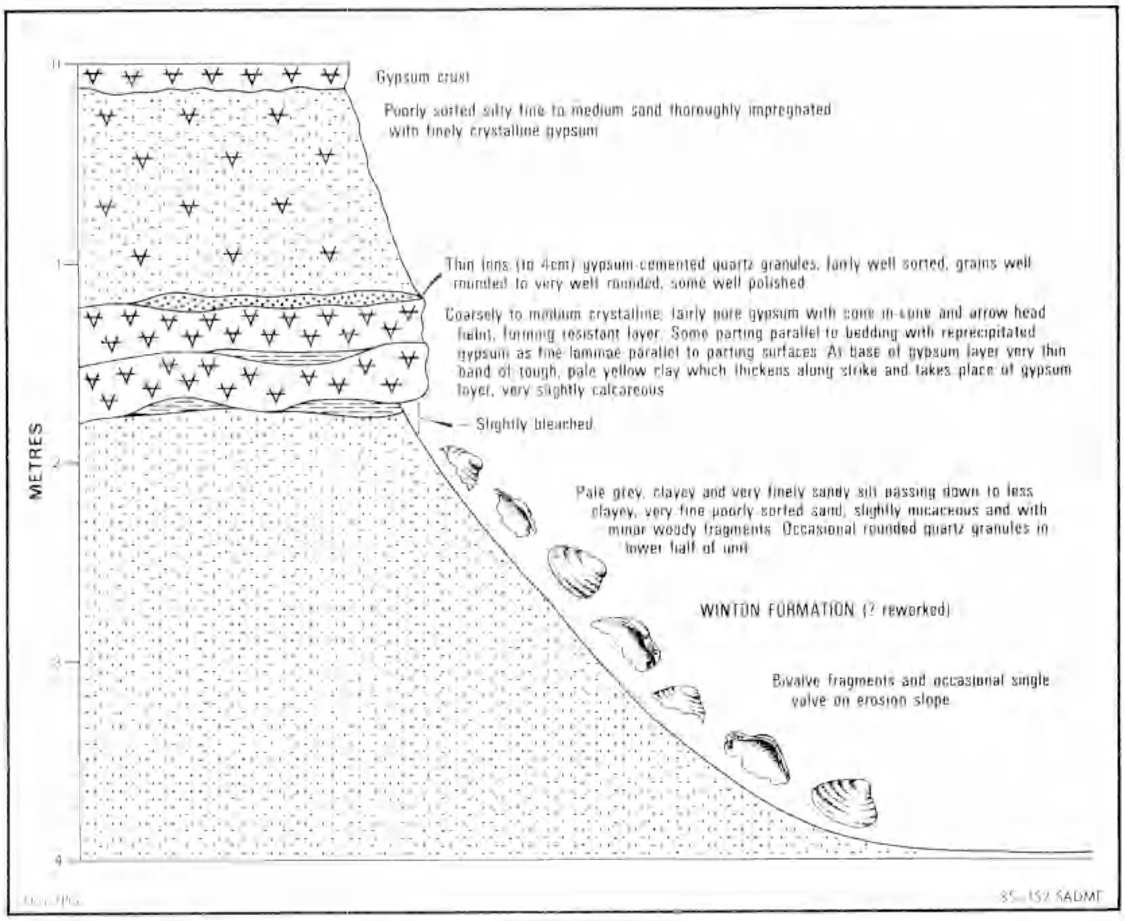

Fig. 2. Composite section of fossil site 6340 RS 4, Lake Eyre North.

Palynological evidence for its Cenomanian age is given by Burger (1982). At this time, following the disruption of Gondwana and extensive marine flooding during the Early Cretaceous, there was a change of regime in the Late Cretaceous and most of the area of the Great Artesian Basin was reduced to a lacustrine remnant (Ludbrook 1978).

Systematic description

Family TRIGONIOIDIDAE Cox, 1952
Genus *PLEDGIA* gen. nov. (fem.)

Shell ovate in shape, elongate-ovate in the juvenile, very thick and heavy, sculpture of concentric growth ridges and concentric lirae. Hinge with anterior teeth relatively short, transversely crenulated, posterior laterals narrow, long, not crenulated.

Pledgia eyrensis gen. et sp. nov.

Material: A total of 19 more-or-less complete specimens and 274 fragments, all from the type locality 6340 RS 4. (Fig.3). South Australian Museum (SAM): the type series, holotype P23999a, paratypes P23999b–g, fragments P23999h–k, all RVs average length 33, average height 23 mm; paratypes P24000a–h, an ontogenetic series of 8 almost complete LVs average length 30, average height 23 mm; P24639a–p, fragments all approximately length 30, height 20 mm; P24640, about 80 fragments.

Geological Survey of South Australia (GSSA): paratypes 10184a, b, 2 RVs a. length 34, height 22, b. length 30, height 19 mm; 10185 paratype 10185a and 16 fragmentary RVs, largest length 40, height (est.) 32, average of 3, length 33, height 22 m; 10186-10192 104 fragmentary RVs and 61 fragmentary LVs.

Description: Valves of medium size, transversely subovate becoming subovate in adult specimens, narrowly rounded anteriorly, slightly produced posteriorly, anterior-dorsal margin well rounded; umbo located at about the anterior one-quarter, moderately high, prosogyrate; shell very thick,

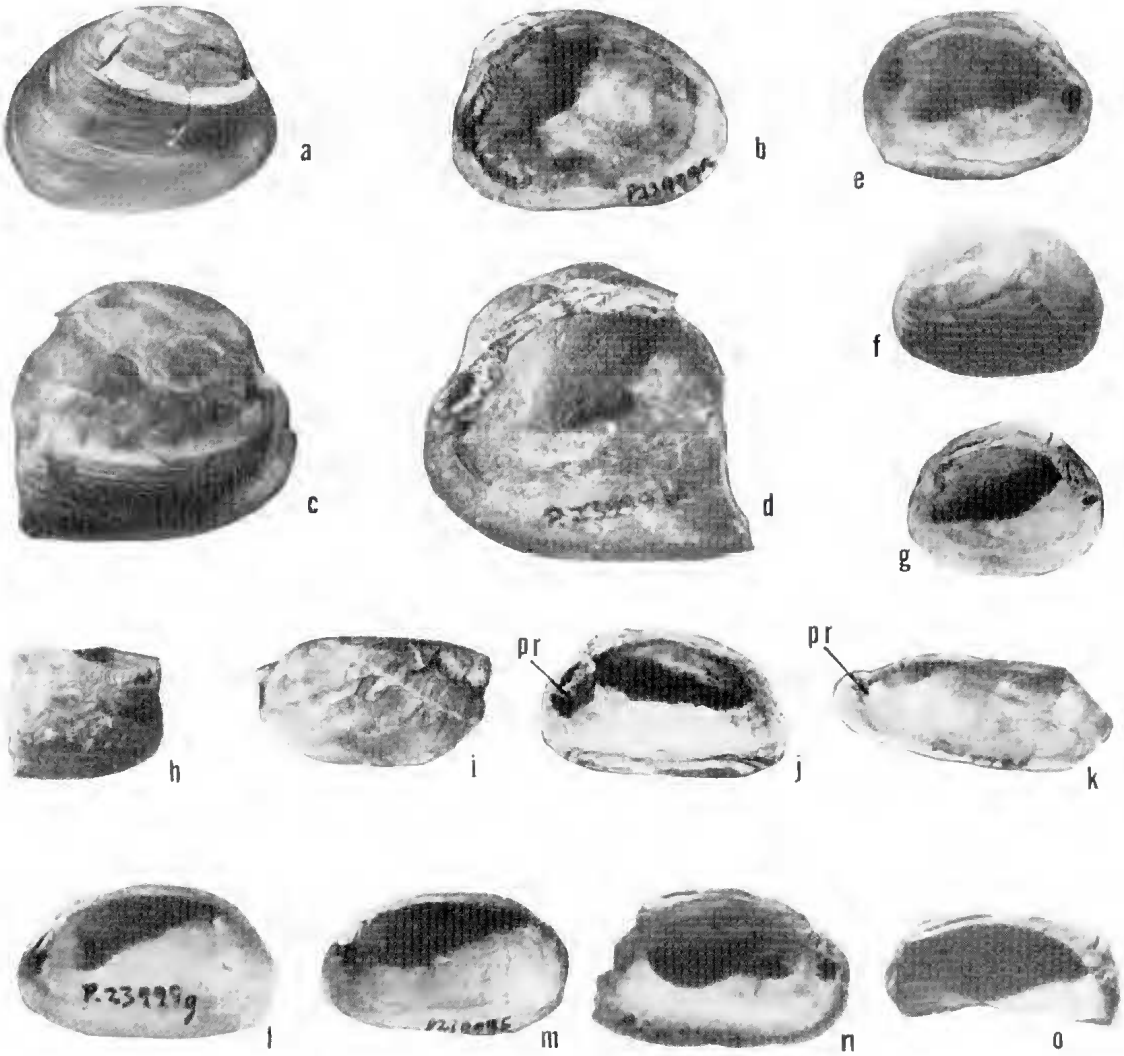

Fig. 3. *Pledgia eyrensis* Ludbrook gen. et sp. nov. a,b. Holotype SAM P23999a RV a. exterior, b. interior; c,d. Paratype SAM P23999b RV large specimen (incomplete) c. exterior showing thick shell with imbricating lamellae, d. interior, worn, with crenulated 3b and deep pit; e,f. Paratype SAM P24000g LV immature specimen e. interior showing deep muscle scars, hinge not fully developed, f. exterior showing radial ridging on both the anterior and posterior slopes; g. Paratype SAM P24000h LV rounded form; h. Paratype SAM P23999h LV fragment showing thick posterior area with radial sculpture; i. Paratype GSSA 10192a LV with differentiated posterior area; j. Paratype GSSA 10184a RV, elongate-oval form with pedal retractor scar just visible under hinge; k. Paratype SAM P23999f, tilted to show pedal retractor; l. Paratype SAM P23999g RV immature specimen, elongate-oval form with anterior cardinal tooth not fully developed; m. Paratype SAM P23999f RV immature specimen, elongate-oval form; n. Paratype SAM P24000b LV immature specimen with well developed posterior laterals, partly developed grooved cardinal, pedal retractor scar visible; o. Paratype GSSA 10185a LV with strong posterior lateral. All figures natural size.

consisting presumably of an outer organic layer or periostracum which is not preserved, an outer very thick (up to 5 mm) calcareous layer composed of successive imbricating lamellae, turned upwards at the ventral margin, which exfoliate very easily leaving the inner layer exposed, and a crystalline inner layer formed of very thin, smooth laminae (see Morton 1967 Fig. 6B) not thickening at the ventral margin. Sculpture on the flank consisting of concentric growth ridges with microscopic concentric lirae between them; faint vestigial radial riblets visible particularly in the anterior part of the flank, a small, thick, posterior area differentiated by having thick radial sculpture. Both the outer and

inner layers are composed of calcite, determined by X-ray diffractometer at the Australian Mineral Development Laboratories (AMDEL Report G584/85). No aragonite was detected. Interior smooth, hinge arcuate with a dental formula of

RV	5	3	PI	PIII
LV		2	PII	PIV

5 is not always present and is crenulated or grooved only in adult specimens, 3 is strong and high, of moderate length and in adult specimens crenulated on both sides with a pit for the reception of 2 in the left valve, PI and PIII are long and narrow, extending the length of the dorsal margin, PII and PIV are fairly long and smooth. The dental formula is somewhat similar to that of *Trigonioides (Wakinoa)* Ota, 1963 as illustrated by Yang (1983). Muscle scars deep, anterior adductor scar close to the anterior margin and to the anterior end of the hinge with a small deep pedal retractor pit above it just under the hinge; posterior adductor scar larger, not so deep, more or less roundly quadrate, pallial line entire, area within the pallial line clearly defined, ventral margin smooth, slightly bevelled but not crenulated.

Distribution: Known only from the type locality 6340 RS 4, Babbage Peninsula, Lake Eyre North; Winton Formation, Cenomanian.

Nomenclature: The generic name is to honour Mr Neville Pledge of the South Australian Museum, who collected many of the specimens and first brought them to my notice.

Discussion: The family Trigonioididae was based on the species *Trigonioides kodairai* now reported from many localities from the USSR to Japan (Yang 1974). The morphology, ontogenetic variation and classification of this and related genera and subgenera have been extensively studied by Martinson (1965) and by Yang (1974, 1976, 1978, 1979, 1983).

Pledgia eyrensis seems to have appeared suddenly in the Cenomanian in Australia, but, unlike the Trigonioididae of Eastern Asia as described by Kobayashi (1958), it is not known to have appeared "sporadically and explosively." No likely non-marine ancestral forms have been found among the Unionidae and there appears to be no close relationship between *Pledgia eyrensis* and the Triassic non-marine unionids (Ludbrook 1961) of the Leigh Creek Coal Basin. Immature forms bear only very slight resemblance in sculpture to the Neocomian *Protovirgus coatsi* Ludbrook 1961, of which the hinge is not known. In shape, sculpture and thickness of shell the adult oval form seems to be most nearly related to the undiagnosed "Trigoniid gen. et sp." of Skwarko (1963 pl. 6, fig. 5) from the Early Cretaceous Wallumbilla Formation south-southwest of Roma, Queensland. This trigoniid is known only from the single specimen figured by Skwarko, which is embedded in hard matrix so that the interior is completely obscured. It does suggest, however, that ancestors of *Pledgia eyrensis* are most likely to be found in the Trigoniidae.

Acknowledgments

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